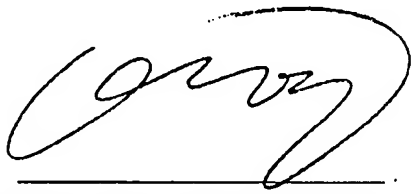
DECLARATION

I, Lae Bong PARK, Patent Attorney, hereby declare the following:

I am knowledgeable in Korean and English. I have reviewed Korean Patent Application No.10-2003-0004928and believe the attached document to be an accurate translation thereof.

All statements made herein of my own knowledge are true and all statements made on information and belief are believed to be true. Further, these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.



Date & Signature: Lae Bong PARK

ABSTRACT

Summary

Disclosed is a method for controlling the stop of an optical disc in an optical disc device. In accordance with this method, a brake voltage application time for the disc stop is calculated with reference to brake voltage application times by reproduction positions of the disc and brake voltage application times by rotation velocity reduction ratios of the disc, and a brake voltage is applied to a spindle motor for the calculated time, such that the disc being rotated can be accurately stopped. Accordingly it is possible to efficiently prevent an error from occurring in a disc stop control operation due to a weight variation or external temperature anomaly of the optical disc.

Key Figure

Figure 4

Key Words

reproduction position of disc, rotation velocity reduction ratio of disc, brake voltage, spindle motor, servo controller

SPECIFICATION

Title

METHOD FOR CONTROLLING STOP OF OPTICAL DISC IN OPTICAL DISC DEVICE

Brief Description Of The Drawings

Fig. 1 is a block diagram showing the configuration of an optical disc device to which a method for controlling the stop of an optical disc according to the present invention is applied;

Fig. 2 is a graph illustrating brake voltage application times by reproduction positions of the disc according to the present invention;

Fig. 3 is a graph illustrating brake voltage application times by rotation velocity reduction ratios of the disc according to the present invention; and

Fig. 4 is a flow chart illustrating the method for controlling the disc stop in the optical disc device according to the present invention.

Major Elements In Drawings

10 : optical disc
11 : spindle motor
12 : sled motor
13 : optical pickup
14 : motor driver
15 : servo controller

Background Of The Invention

The present invention relates to a method for controlling the stop of an optical disc in an optical disc device, such as a digital versatile disc (DVD) player or compact disc (CD) player, which is capable of more accurately stopping the optical disc being rotated by a spindle motor.

Recently, an optical disc capable of storing long-term high-quality video data and long-term high-quality audio data, such as a DVD, has been developed, introduced to the market and made commercially available. An optical disc device capable of reproducing or recording video and audio data from/on a DVD, such as a DVD player or DVD recorder, has also been developed, introduced to the market and made commercially available.

Such an optical disc device, for example, a DVD player, is adapted to read a data stream recorded on a DVD, decode

and restore the read data stream into the original video and audio signals, digital/analog (D/A)-convert the restored video and audio signals and output the resulting video and audio signals through a general television receiver, respectively, as picture and sound. As a result, a user can watch and listen to the video and audio recorded on the DVD through the general television receiver.

Meanwhile, the above-mentioned optical disc device performs a spindle servo control operation. In this operation, if an optical disc is loaded in the device, then a spindle motor is driven to rotate the optical disc at high speed. Thereafter, if the stop of a reproduction operation is requested, then a brake voltage is applied to the spindle motor for a predetermined period of time to stop the rotation of the optical disc.

However, the aforementioned optical disc device has a disadvantage in that, when a weight variation or external temperature anomaly of an optical disc loaded in the device is beyond the range of a predetermined allowable error, an error occurs in the spindle servo control operation, thereby making it impossible to accurately stop the optical disc being rotated.

Explanation Of The Invention

Therefore, the present invention has been made in view of the above problem, and it is an object of the present invention to provide a method for controlling the stop of an optical disc in an optical disc device, such as a DVD player or CD player, which is capable of calculating a brake voltage application time for the disc stop with reference to brake voltage application times by reproduction positions of the disc and brake voltage application times by rotation velocity

reduction ratios of the disc, and applying a brake voltage to a spindle motor for the calculated time, thereby accurately stopping the disc.

In accordance with the present invention, the above and other objects can be accomplished by the provision of a method for controlling stop of an optical disc in an optical disc device, comprising the steps of: a) detecting a rotation velocity of the disc being rotated by a spindle motor and a rotation velocity reduction ratio of the disc based on a velocity reduction of the spindle motor; b) calculating a brake voltage application time with reference to the detected disc rotation velocity and disc rotation velocity reduction ratio; and c) applying a brake voltage to the spindle motor for the calculated time to stop the disc.

Now, a method for controlling stop of an optical disc in an optical disc device according to a preferred embodiment of the present invention will be described with reference to the annexed drawings.

With reference to Fig. 1, there is shown in block form the configuration of an optical disc device to which a method for controlling the stop of an optical disc according to the present invention is applied. As shown in this drawing, the optical disc device, for example, DVD player, comprises a spindle motor 11, a sled motor 12, an optical pickup 13, a motor driver 14 and a servo controller 15.

The spindle motor 11 is driven by a drive voltage from the motor driver 14 to rotate, at high speed, an optical disc 10 loaded in the device, and the sled motor 12 is driven by a drive voltage from the motor driver 14 to move the optical pickup 13 horizontally in parallel with a recording surface of the optical disc 10.

The servo controller 15 is adapted to perform a spindle

servo control operation of, in response to a focus error signal, tracking error signal and radio frequency (RF) signal from a photo detector included in the optical pickup 13, driving the spindle motor 11 and sled motor 12 and stopping the optical disc 10 being rotated at high speed by the spindle motor 11.

The servo controller 15 is also adapted to detect a rotation velocity of the optical disc 10 with reference to information regarding a position of the disc being currently reproduced. The servo controller 15 detects a higher rotation velocity of the spindle motor 11 when the position of the disc being currently reproduced approximates to the inner periphery of the disc, an intermediate rotation velocity when it corresponds to the middle position of the disc, and a lower rotation velocity when it approximates to the outer periphery of the disc.

The servo controller 15 is also adapted to apply a constant brake voltage to the spindle motor 11 to stop the disc being rotated. As shown in Fig. 2, the brake voltage is applied for a longer period of time until the disc stops when the rotation velocity of the optical disc 10 is higher as in a position of the disc approximating to the inner periphery thereof, for an intermediate period of time until the disc stops when it is intermediate as in the middle position of the disc, and for a shorter period of time until the disc stops when it is lower as in a position of the disc approximating to the outer periphery thereof.

The servo controller 15 is also adapted to, if a disc stop mode is set, reduce a current rotation velocity V1 of the spindle motor 11 to a desired rotation velocity V2 and then detect a rotation velocity reduction ratio a, b or c of the optical disc 10 based on the reduced rotation velocity. For example, as shown in Fig. 3, in the case where the

optical disc 10 is heavier in weight than a general optical disc, the rotation velocity reduction ratio is lower. If the optical disc 10 is similar in weight to the general optical disc, the rotation velocity reduction ratio is intermediate. Where the optical disc 10 is lighter in weight than the general optical disc, the rotation velocity reduction ratio is higher.

Therefore, if the disc stop mode is set, the servo controller 15 detects a disc rotation velocity and a disc rotation velocity reduction ratio, calculates a brake voltage application time with reference to the detected rotation velocity and rotation velocity reduction ratio and applies the brake voltage to the spindle motor 11 for the calculated time, as will hereinafter be described in detail.

Fig. 4 is a flow chart illustrating the method for controlling the disc stop in the optical disc device according to the present invention. If the optical disc 10 is loaded in the optical disc device, for example, DVD player (S10), the servo controller 15 performs an initial servo operation (S11). In this servo operation, the servo controller 15 controls the motor driver 14 to apply a drive voltage to the spindle motor 11 so as to rotate the optical disc 10 at high speed. The servo controller 15 also applies a drive voltage to the sled motor 12 to move the optical pickup 13 horizontally in parallel with the recording surface of the optical disc 10.

Upon receiving a reproduction stop request from the user in the middle of performing a data reproduction operation of reading/reproducing A/V data recorded on the optical disc 10, the servo controller 15 sets a disc rotation stop mode (S12). Then, as stated previously with reference to Fig. 2, the servo controller 15 detects a rotation velocity of the optical disc 10 with reference to information regarding a

position of the disc being currently reproduced, for example, sector number information of a data position being currently reproduced if the disc is a DVD and time MSF information of a data position being currently reproduced if the disc is a CD (S13).

As stated previously with reference to Fig. 3, the servo controller 15 also reduces a rotation velocity of the spindle motor 11 to a desired rotation velocity and then detects a rotation velocity reduction ratio of the optical disc 10 based on the reduced rotation velocity (S14). The reduction ratio is obtained by dividing the difference between a disc rotation velocity after the reduction and a disc rotation velocity before the reduction by a period of time required until the reduction.

The servo controller 15 then calculates a brake voltage application time with reference to the disc rotation velocity and disc rotation velocity reduction ratio detected in the above manner (S15) and applies the brake voltage to the spindle motor 11 for the calculated time (S16). The brake voltage application time is in inverse proportion to the rotation velocity of the disc and the rotation velocity reduction ratio of the disc.

Thereafter, the servo controller 15 continuously monitors whether the disc 10 is stopped while applying the brake voltage to the spindle motor 11 (S17). If the disc is stopped earlier than expiration of the brake voltage application time, then the servo controller 15 stops the application of the brake voltage.

Although the preferred embodiments of the invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the

scope and spirit of the invention as disclosed in the accompanying claims.

Effect Of The Invention

As apparent from the above description, the present invention provides a method for controlling the stop of an optical disc in an optical disc device, which is capable of efficiently preventing an error from occurring in a disc stop control operation due to a weight variation or external temperature anomaly of the optical disc.

WHAT IS CLAIMED IS:

1. A method for controlling stop of an optical disc in an optical disc device, comprising the steps of:

a) detecting a rotation velocity of said disc being rotated by a spindle motor and a rotation velocity reduction ratio of said disc based on a velocity reduction of said spindle motor;

b) calculating a brake voltage application time with reference to said detected disc rotation velocity and disc rotation velocity reduction ratio; and

c) applying a brake voltage to said spindle motor for said calculated time to stop said disc.

2. The method as set forth in claim 1, wherein said rotation velocity of said disc is detected based upon information regarding a position of said disc being currently reproduced.

3. The method as set forth in claim 1, wherein said rotation velocity reduction ratio of said disc is detected based upon a reduced rotation velocity of said disc after the

lapse of a predetermined period of time from a start point time of said velocity reduction of said spindle motor.

4. The method as set forth in claim 1, wherein said rotation velocity reduction ratio of said disc is detected based upon of a period of time required until a current rotation velocity of said disc is reduced to a predetermined rotation velocity.

5. The method as set forth in claim 1, wherein said brake voltage application time is in inverse proportion to said rotation velocity of said disc and said rotation velocity reduction ratio of said disc.

6. The method as set forth in claim 1, wherein said step a) includes the steps of:

a-1) detecting said rotation velocity of said disc being rotated by said spindle motor;

a-2) reducing said detected rotation velocity of said disc to a predetermined rotation velocity; and

a-3) detecting said rotation velocity reduction ratio of said disc based upon a period of time required until said rotation velocity of said disc is reduced to said predetermined rotation velocity.

FIG. 1

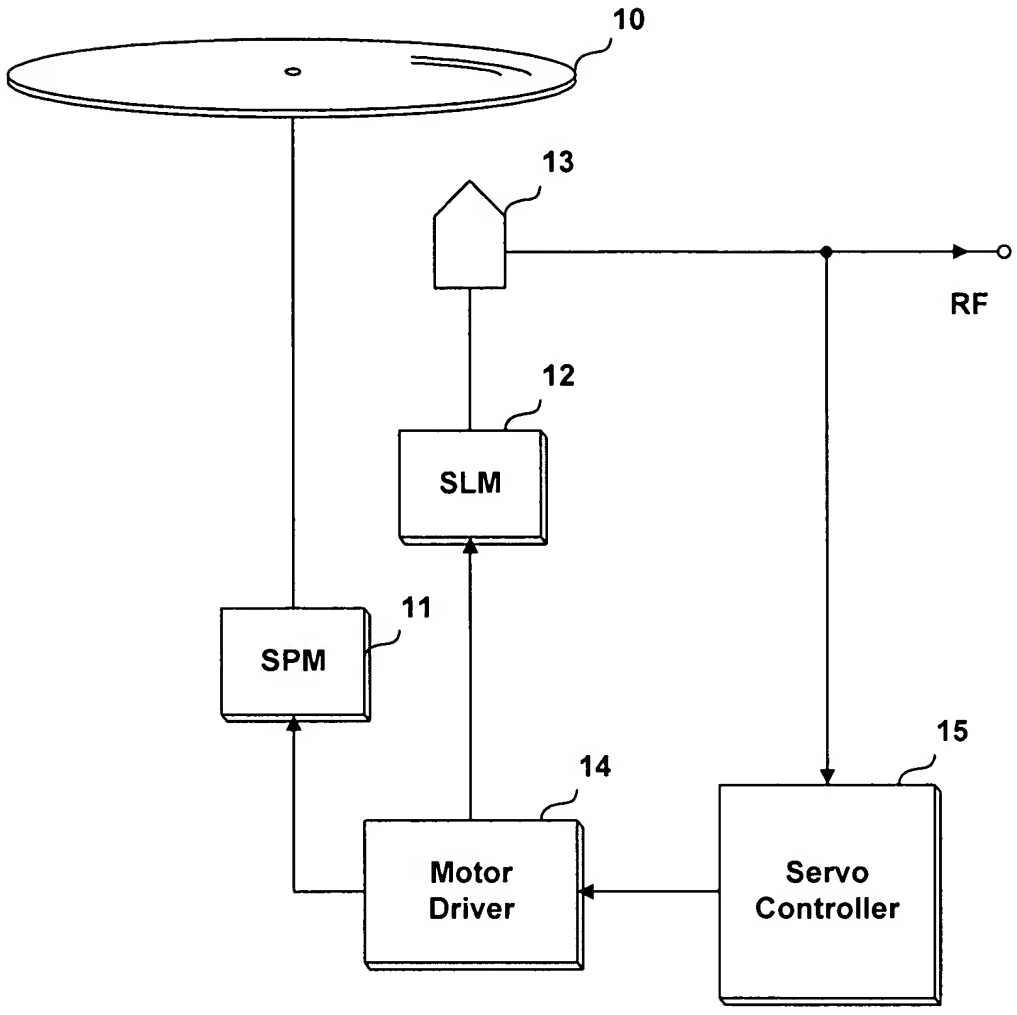


FIG. 2

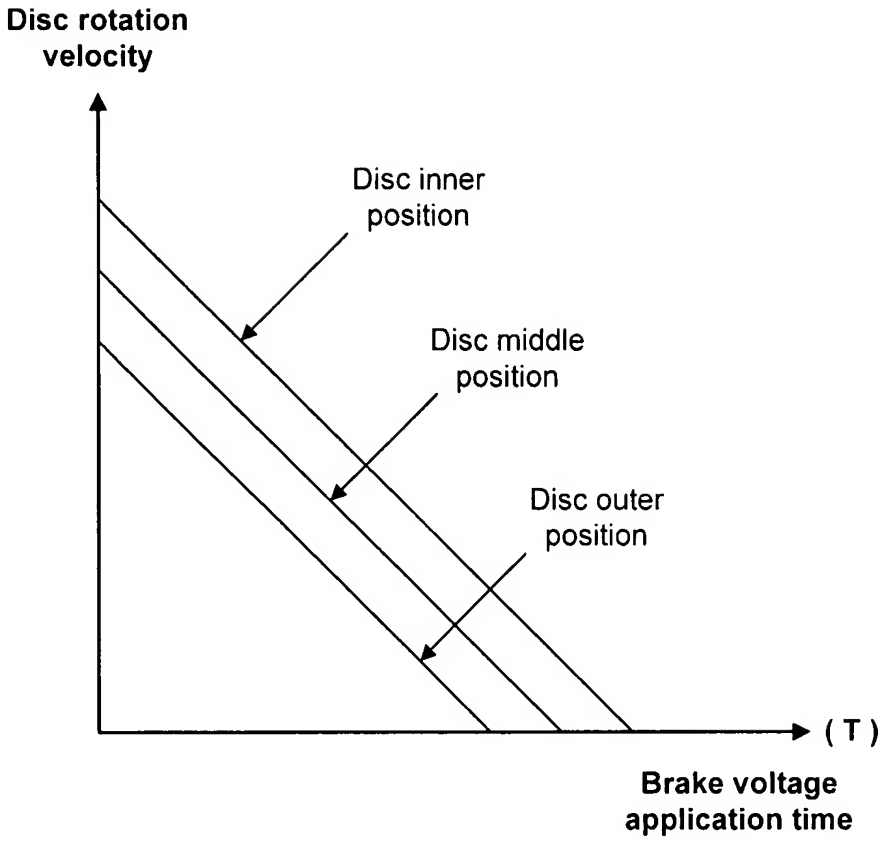

Disc rotation velocity
Disc inner position
Disc middle position
Disc outer position
(T)
Brake voltage application time

FIG. 3

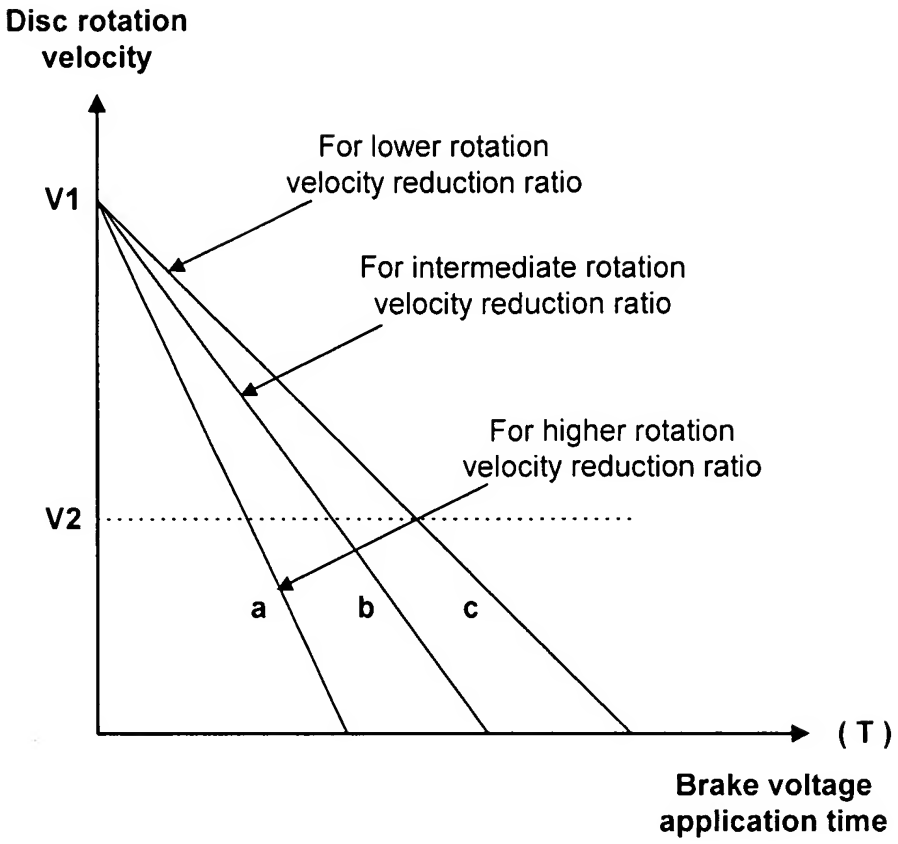
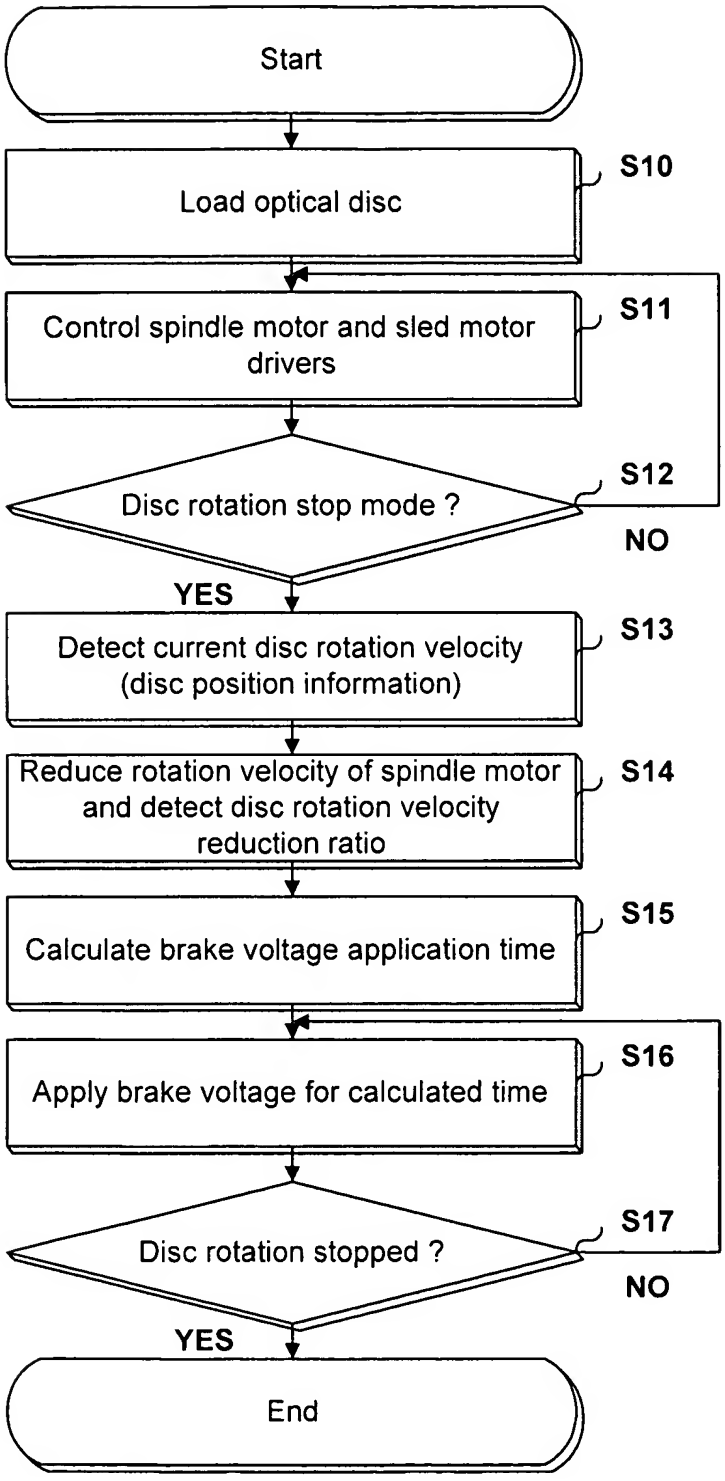

Disc rotation velocity
V1
V2
For lower rotation velocity reduction ratio
For intermediate rotation velocity reduction ratio
For higher rotation velocity reduction ratio
a
b
c
(T)
Brake voltage application time

FIG. 4


Start
Load optical disc
S10
Control spindle motor and sled motor drivers
S11
Disc rotation stop mode ?
S12
NO
YES
Detect current disc rotation velocity (disc position information)
S13
Reduce rotation velocity of spindle motor and detect disc rotation velocity reduction ratio
S14
Calculate brake voltage application time
S15
Apply brake voltage for calculated time
S16
Disc rotation stopped ?
S17
NO
YES
End